J Rehabil Med 2004; Suppl. 43: 76–83

Taylor & Francis healthsciences

NON-SURGICAL INTERVENTION AND COST FOR MILD TRAUMATIC BRAIN INJURY: RESULTS OF THE WHO COLLABORATING CENTRE TASK FORCE ON MILD TRAUMATIC BRAIN INJURY

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We examined the evidence for non-surgical interventions and for economic costs for mild traumatic brain injury patients by a systematic search of the literature and a best-evidence synthesis. After screening 38,806 abstracts, we critically reviewed 45 articles on intervention and accepted 16 (36%). We reviewed 16 articles on economic costs and accepted 7 (44%). We found some evidence that early educational information can reduce long-term complaints and that this early intervention need not be intensive. Most cost studies were performed more than a decade ago. Indirect costs are probably higher than direct costs. Studies comparing costs for routine hospitalized observation vs the use of computerized tomography scan examination for selective hospital admission indicate that the latter policy reduces costs, but comparable clinical outcome of these policies has not been demonstrated. The sparse scientific literature in these areas reflects both conceptual confusion and limited knowledge of the natural history of mild traumatic brain injury.

Key words: mild traumatic brain injury, treatment, economic cost.

J Rehabil Med 2004; suppl. 43: 76–83

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INTRODUCTION

The vast majority of patients with mild traumatic brain injury (MTBI) patients have a medically uneventful early clinical course. Early intervention for these patients is usually focused on the identification and treatment of serious complications and then on the prevention of long-term symptoms and disability. Much attention has been paid to the identification and treatment of the minority of patients at risk for severe intracranial complications and the need for neurosurgical and intensive care (1). However, for the majority of patients with MTBI this is not a concern. Nevertheless, there is a subgroup of patients who present persisting or evolving symptoms and disability and need for non-surgical intervention. One goal is to identify these patients early and to intervene in a way to prevent a poor outcome. In this respect, prognostic studies are important, since they can inform us about factors that predict poor outcomes that might be modified by early intervention (2).

The purpose of this report is to review the literature on non-surgical interventions for MTBI, to provide evidence-based recommendations and to identify gaps in the evidence for recommendations on further research. Secondly, we have reviewed the available cost studies on MTBI to summarize the economic impact of the condition.

METHODS

The search and review strategy is outlined in detail in another paper in this supplement (3). Briefly, we performed a comprehensive search of the world literature on MTBI using the following databases: Medline and PsycINFO (1980–2000), Cinhal (1982–2000) and Embase (1988–2000). These were searched using indexed thesaurus terms (e.g. Medical Subject Headings for Medline) and text words concussion, mild head injury and others, to ensure that all relevant articles were captured. Abstracts identified in the literature search were screened for relevance to the task force mandate. Articles were considered relevant if they addressed diagnosis, incidence, risk factors, prevention, prognosis, treatment and rehabilitation, or economic costs of MTBI; if they contained data and findings specific to MTBI; or if they described a systematic review of the literature on MTBI. Studies on penetrating brain injuries, shaken-baby syndrome and studies using non-human subjects, cadavers, crash-test dummies or biomechanical simulations were excluded. Small case series with fewer than 10 subjects were excluded, unless they pertained to rare complications of MTBI, such as second impact syndrome. In order to enhance complete ascertainment of the literature on MTBI, we also checked reference lists from relevant articles and solicited literature from experts in the field, through a website, and through contact with brain injury associations. Studies prior to 1980 were included if they were considered by task force members to be "seminal papers". A last Medline search was performed in the spring 2002 for studies published in 2001. Only those articles from 2001 that we judged as having a high impact were included, such as randomized controlled trials, large cohort and case-control studies and studies pertaining to areas for which we had little prior evidence. Furthermore, high impact studies published in 2002 were included but we did not undertake a systematic search (3).

We formed rotating, working pairs to independently review each article identified as relevant. They identified biases, strengths and weaknesses, and extracted data systematically into our critical review software. The entire scientific secretariat then discussed each article and arrived at a consensus judgment about its scientific merit. All articles that were judged to be scientifically acceptable by our review are summarized in evidence tables as part of our best-evidence synthesis.

RESULTS

Studies related to intervention

After screening 38,806 abstracts, 45 of them were critically reviewed and 16 (36%) articles on intervention for MTBI were accepted. Nine of these are randomized controlled trials (RCTs) (4–12), 1 is a controlled trial (13) and 1 is a cohort study (14). Of these 11 analytical studies, 1 addresses the use of a homeopathic remedy and 2 address medications (4, 13, 14). The remaining 8 studies address the effect of management and information polices on MTBI (5–12). Extracted data from these 11 studies are presented in Tables I and II. The other 5 intervention studies include 4 clinical descriptive case studies (15, 16–18) and 1 guideline report (19) addressing various aspects on the management of MTBI.

Trials with medications or homeopathy

The task force accepted 3 treatment trials of medications or homeopathy for MTBI. All have small sample sizes and test different substances at different time intervals after the injury. As such, these studies provide only weak evidence concerning intervention effectiveness.

In 1 non-randomized controlled trial (13), an intranasal vasopressin analogue was tested in patients with acute MTBI (Table I). A daily 2-mg dose was administered during the first 3 months after the injury, and compared with a placebo. Cognitive performance was repeatedly assessed during the treatment period. There was no significant difference observed in cognitive performance between the treatment and control groups, but the sample size was small, with 16 patients per group.

Two other studies of intervention address complaints at 3 months or longer after MTBI. One cohort study (Table II) examined the effect of an antidepressant drug on depression and cognition in an 8-week, non-randomized, single-blind, placebo, run-in trial (14). A group of patients, who had sustained a MTBI within 3–24 months prior to treatment and who fulfilled the DSMIII-R criteria for major depression and with a minimum score of 18 on the Hamilton Depression Rating Scale (HAM-D) (14), were studied. The selective serotonin re-uptake inhibitor (SSRI) sertraline, 25–200 mg per day, depending on clinical response and tolerability, was compared with a placebo to alleviate depression and improve cognition. Overall, there was no response to the placebo and only 2 patients did not respond positively to sertraline. Ten of the treated patients had a complete remission of their depression. Improvements in cognitive performance, as assessed at entry and after 8 weeks of treatment, were also seen with sertraline therapy, including improved psychomotor speed, verbal and visual recent memory, cognitive efficiency and self-perception of cognitive symptoms. The study design limits definitive conclusions about effectiveness, but the trial suggests that sertraline alleviates depression, even in patients with MTBI, and that improvement in mood may have a positive effect on cognitive performance.

One RCI addresses homeopathic treatment for MTBI (4). Patients who suffered a MTBI 4 months to 16 years before the study were randomized to active treatment or a placebo (Table I). Active treatment was a homeopathic medicine, selected by 2 physicians, based on the individual characteristics of the patient, and administered sublingually. The active treatment group had a significant reduction of commonly reported symptoms of MTBI. They also showed improvement over the placebo group on scales measuring activities of daily living. Even though the study was well designed, it is not clear how the individualized treatments can ever be replicated. Therefore, recommendation of this therapy is not possible.

Management and information policies

The task force accepted 8 RCTs on management and information policies for patients with MTBI (5–12). Only 1 of these studies concerned the management of children with MTBI (12), the others dealt with adults. The most consistent evidence is provided by 5 studies that address various forms of early educational information (5–9). Two reports from the same study compare outcomes from interventions for MTBI at 3 months (5) and 12 months (6). The study compared a single session of education and reassurance with the same intervention plus neuropsychological and physical therapy assessment and any additional treatment-as-needed (Table I). Both interventions were initiated within 3 weeks of the injury. This study included 119 consecutive adult admissions to 2 hospital emergency wards. Patients were randomly assigned to each group. Outcome was assessed at 3 months in 111 patients and at 12 months in 105 patients. This assessment included the brain injury Problem Check List, the Community Integration Questionnaire, Short Form-36 (SF-36) Health Survey, and occupational status pre- vs post-injury. There were no significant differences in any of the outcome measures between treatment groups at 3 or 12 months. These results indicate that the single session intervention was as effective as the more elaborate assessment and intervention, and many participants had returned to work before the intervention (i.e. an average of 3 weeks post-injury). Few patients required further MTBI treatment, and few patients in the intensive intervention group had persisting symptoms, or sought the optional treatment that was offered, which included psychological and physical therapy intervention for MTBI complaints. Associated injuries, such as musculoskeletal injuries and pain, were responsible for more treatment visits to healthcare professionals than were any MTBI-related complaints. The study does not rule out that the lack of treatment effect may be due to a lack of persistent symptoms in the participants. However, the study provides evidence that an early, single-session, education-oriented treatment is as useful as more elaborate interventions in most cases, and that the routine

Table I. *Studies on intervention of mild traumatic brain injury (MTBI)*

Authors and study design	Setting and study sample size (*n*)	Inclusion criteria	Intervention evaluated and number (*n*) per treatment arm	Outcome measures and follow-up period	Main findings and limitations
Bohnen et al., 1993 (13) NRCT	University hospital, Netherlands ($n = 39$)	Acute MTBI, GCS $\geq$13, LOC <15 minutes, PTA $\leq$60 minutes, age 15–70 years	Intranasal Vasopressin analogue arginine (DGAVP) ($n = 16$) compared with placebo ($n = 16$), during the 3-month period post-injury	PCS using a 7-item questionnaire and 3 different cognitive tests. Follow-up at 84 days post injury	No clinically important benefit for DGAVP shown
Chapman et al., 1999 (4) RCT	University hospital, US ($n = 61$)	MTBI with persistent PCS >3 months, age $\geq$18 years	Individual homeopathic treatment ($n = 37$) compared with placebo ($n = 23$) during a 4-month period	Disability measured by an 18-item Difficulty in Situations Scale, PCS measured by a 34-item Symptom Rating Scale and a Cognitive Linguistic Test Battery at end of treatment period	Both groups improved, but the homeopathic treatment group had a significant reduction in symptoms and disability, but not in cognitive tests scores. Not clear what clinical importance the observed differences between groups have. Not clear how the individualized treatment can be replicated
Paniak et al., 1998, 2000 (5, 6) RCT	Rehabilitation hospital, Canada, ($n = 119$)	GCS 13–15, LOC $\leq$30 minutes, PTA $\leq$24 hours or retrograde amnesia, admitted to hospital	Single Session Intervention (SS) ($n = 58$), including information was compared with Treatment as Needed (TAN) ($n = 53$), including intensive intervention with neuropsychological consultation and individual additional treatment	Problem checklist, Community Integration Questionnaire, and Short Form-36 (SF-36) with 3 months follow-up in the 1998 publication and 12 months in the 2000 publication	No difference between SS and TAN at either 3 or 12 months
Wade et al., 1997 (7) RCT	ED and Trauma Services in Oxfordshire, UK ($n = 1156$)	All severities of TBI (80% were not admitted to hospital), age 16–65 years	In addition to the standard hospital care, intervention patients ($n = 254$) received early follow-up service (7–10 days post injury) including advice, information, further assessment, and treatment if required. The control patients ($n = 226$) received just standard hospital care	PCS using Rivermead Post Concussion Symptom Questionnaire and social disability using Rivermead Head Injury Follow-up Questionnaire. Follow-up at 6 months post injury	No benefit from routine follow-up except for a subgroup of patients with PTA >1 hour or admitted to hospital. The study also included moderate and severe brain injuries. Recall bias is possible since PTA was assessed at follow-up. Attrition bias is possible due to the large proportion lost to follow-up (59%)
Wade et al., 1998 (8) RCT	ED and Trauma Services in Oxfordshire, UK ($n = 314$)	All severities of TBI admitted to hospital, age 16–65 years	Same as in Wade et al. 1997 (7). Intervention group ($n = 132$) and control group ($n = 86$)	Same as in Wade et al. 1997 (7)	Less social disability in the intervention group. Recall bias is possible since PTA was assessed at follow-up
Mittenberg et al., 1996 (9) RCT	General hospital, US ($n = 58$)	GCS 13–15, GOAT scores above 75	Patients ($n = 29$) who received written extensive instructions and met with a therapist prior to hospital discharge were compared with control patients ($n = 29$) receiving routine discharge information, including written information and an advised period of rest	Presence, duration and severity of PCS using a 12-item questionnaire at 6 months follow-up	The treatment group reported significantly shorter symptom duration and fewer symptoms when compared with control patients. The validity of the outcome measures is not clear. It is unknown if the observed improvement is an effect of cognitive therapy, or an iatrogenic effect of routine care

Authors and study design	Setting and study sample size (n)	Inclusion criteria	Intervention evaluated and number (n) per treatment arm	Outcome measures and follow-up period	Main findings and limitations
Lowdon et al., 1989 (10) RCT	University hospital, UK ($n = 111$)	LOC <15 min, age 18–50 years	Admission ($n = 33$) to hospital as a prophylactic treatment for PCS compared with discharge ($n = 44$) from the ED with instructions only	Presence and duration of PCS using a 6-item questionnaire, and time off work at 6 weeks follow-up	Of the total study sample, 90% had symptoms that lasted an average of 2 weeks. The discharged group had less memory problems and a non-significant shorter time off work. Admission to hospital did not reduce the presence or duration of symptoms
Relander et al., 2002 (11) RCT	University hospital, Finland ($n = 178$)	Referred patients with cerebral concussion, not further defined, age ≥6 years	Active treatment ($n = 82$), including encouragement to early activity, physiotherapy and information about the injury. Controls ($n = 96$) could stop bed rest whenever they wanted and received no specific information about the injury	Number of days in bed, days in hospital and number of days off work	No significant difference between groups in number of days in bed or days in hospital. Active treatment resulted in a significantly lower number of days off work compared with controls. Only 59 patients were included in the follow-up analysis of days off work. Unknown which component of active care is most useful
Casey et al., 1987 (12) RCT	University hospital, US ($n = 321$)	Age 6 months –14 years. Head trauma without LOC and enrolled within 24 hours of their ED visit	Intervention group ($n = 103$) of parental education, including a discharge interview with explanation of a take-home booklet of symptoms to expect and instructions to follow. Control group ($n = 101$), including routine discharge instructions consisting of a list of symptoms requiring reassessment at the hospital	The child's current and prior health, social health (quality of the child's interpersonal interaction with others) and behavioural problems, using 3 different measurements depending on the age of the child. School absenteeism and parent's anxiety also measured. Follow-up at 1 month	Parental education had no effect. Subsequent morbidity was correlated to the parent's anxiety at baseline

NRCT = non-randomized controlled trial; GCS = Glasgow Coma Scale; LOC = loss of consciousness; PTA = post-traumatic amnesia; PCS = post-concussion symptoms; RCT = randomized controlled trial; ED = emergency department; TBI = traumatic brain injury; GOAT = Galveston Orientation and Amnesia test.

Table II. *Observational study of intervention in patients with mild traumatic brain injury (MTBI)*

Authors and study design	Setting and sample size (*n*)	Inclusion criteria	Intervention evaluated	Outcome measures and follow-up period	Main findings and limitations
Fann et al., 2001 (14) Cohort	Community-based sample recruited using advertisements in local newspapers and health magazines in the USA. (*n* = 15)	Recruited through newspapers and health magazines, age 18–60 years, MTBI in the last 3–24 months, DSM-IIIR diagnosis of major depression, minimum of 18 on the Hamilton Depression Rating Scale (HAM-D)	One week of treatment with a placebo drug followed by an 8-week period of treatment with the antidepressive drug Sertraline	HAM-D, 10 different cognitive tests and self-rated perception of the severity of the brain injury assessed during and at end of treatment period	Depression scores (HAM-D) improved in the treated patients between baseline and the 8-week follow up. Ten out of 15 patients had complete remission of depression. Improvements were observed in cognition in 14 of the 24 subtests in treated patients. The study indicates that the drug relieves depression in MTBI cases, and this has a positive effect on cognitive performance. Non-randomized design limits the conclusions

DSM-IIIR = Diagnostic and Statistical Manual of Mental Disorders – third revision.

provision of intensive treatment is not of particular benefit in this patient population. In addition, the study shows the importance of associated complaints due to other injuries in determining outcomes in patients with MTBI.

Two RCTs (7, 8) from Oxford, UK involved intervention by a specialized, early follow-up approach at 7–10 days after head injury. The intervention included an interview (face-to-face or by telephone) by a senior occupational therapist or a senior clinical psychologist, advice, information and reassurance when appropriate (Table I). It also included referral within a formalized Head Injury Service to occupational therapy, physiotherapy, or psychotherapy as required. Patients were randomized to the specialized early follow-up service, or to ordinary access to existing hospital services, which did not include routine follow-up or admission to hospital after uncomplicated head injury. In a first study, the intervention was evaluated in all patients presenting to hospital with a head injury of any severity (7). Patients with trivial injuries, which included those with no history of loss of consciousness (LOC) or post-traumatic amnesia (PTA), were also included in the study. Follow-up assessment at 6 months included the Rivermead Postconcussion Symptom Questionnaire and the Rivermead Head Injury Follow-up Questionnaire. There was no benefit associated with the early follow-up service, except in the subgroup of patients with PTA of more than 1 hour and in those admitted to hospital, which included those with moderate and severe brain injuries. However, more than half of the randomized patients were lost to follow-up, and the results might have been contaminated by other interventions during the trial. In a further study (8), only patients that were admitted to hospital were included. Those patients receiving the early follow-up service through the Head Injury Service had better outcomes than the usual care group. The intervention group had significantly less social disability and lower ratings of post-concussion symptoms at 6-months after the injury than the control group. Patients with mild and moderate brain injury benefited more from the intervention than those with severe injuries.

In 1 small RCT, the value of a structured cognitive behavioral intervention for the prevention of persisting symptoms was examined in patients admitted to hospital for MTBI (9). The intervention group received a 10-page manual entitled “Recovering from Head Injury: A Guide for Patients”. They also met with a therapist to review the nature and incidence of expected symptoms, received an explanation of a cognitive-behavioral model of symptom maintenance and treatment, were shown techniques for reducing symptoms, and were given instructions for gradual resumption of premorbid activities (Table I). The control group received routine hospital treatment and discharge instructions in written form and met with their regular nurse to review and discuss these. Patients were told to return to their doctor or to the emergency department if they experienced persistent headache of increasing severity, memory problems, difficulty concentrating, dizziness, visual difficulties, difficulties with coordination, or nausea. A period of rest was also advised.

Follow-up assessment was at 6 months by a structured symptom checklist. No loss to follow-up was reported. The intervention group experienced significantly fewer symptomatic days and lower mean severity levels of symptoms than the control group. There was a decrease in the proportion of patients with symptoms at 6 months compared with baseline in the intervention group. However, other healthcare use was not monitored, and the clinical importance of the outcome is not clear.

In summary, there is some evidence (7–9) that an early educational intervention that includes reassuring information about the high probability of a good recovery and advice and encouragement on gradual return to regular activities helps patients with MTBI. The study by Paniak et al. (5) yields evidence that intensive interventions are not useful for most patients with MTBI. Therefore, our task force recommends that patients with acute MTBI should be provided with simple educational materials and reassurance.

There was 1 study addressing what effect hospitalization might have on post-concussion symptoms (10). The hypothesis, that the severity of post-concussion symptoms would be greater in patients discharged directly from an emergency department without the care and reassurance provided by admission to hospital, was tested in a RCT (Table I). The results show that admission to hospital did not reduce the incidence or severity of these symptoms. The study must be interpreted cautiously because of the small sample size and because almost one-third of the patients were lost to follow-up.

Another RCT compared 2 treatment regimens of in-hospital care for patients with concussion (11). The active regimen included encouraging patients to get up from bed rest as early as possible, physiotherapy and educational information about the injury (Table I). To maintain continuity, the same physiotherapist supervised active therapy and saw the patient twice a week in the outpatient department until the end of treatment. The duration of this treatment is not reported. Patients receiving active therapy were encouraged to attend follow-up clinics, where they saw the same physician who had treated them in hospital and were encouraged to resume normal activities as soon as possible. This was compared with conventional management, where patients were allowed, but not specifically encouraged, to get up from bed rest. They also received information about the injury, but only if they asked for it. No arrangements were made for them to see the same physician at follow-up. The number of days in bed, the number of days in hospital and the number of days off work were compared. The active intervention resulted in significantly fewer days off work compared with controls. However, children aged 6 years or older were included, and the number of employed patients was not reported. Furthermore, it is not clear what component of the active regime was useful. Nevertheless, the study supports early activation in patients with MTBI.

The task force accepted only one study on the management of MTBI in children. This study addresses educational intervention given to parents of children aged 6 months to 14 years and presenting with "minor head trauma" (Table I) (12). Excluded from this study were children with LOC and those admitted to hospital. Data on PTA were not reported. Parents in the intervention group received discharge information from a nurse on potential symptoms to expect and instructions to follow. Parents in the control group only received routine discharge instructions. Parents' attitudes toward MTBI and their healthcare use for this problem were also examined. Outcome assessment was by telephone interview at 1 month post-injury. This assessment included questions about the child's current and prior physical health, the parents' perceptions of the child's susceptibility to illness, the parents' level of concern about the child's health, the child's social or functional limitations and behavioral problems during the month elapsed since the injury. The results indicate similar levels of physical health status, role activity indices and behavior problems in the intervention and control groups. Subsequent child morbidity occurred more often among children of anxious parents. This study may indicate the importance of parents' anxiety in increasing morbidity in children with MTBI without LOC.

Various aspects of management

Two clinical descriptive studies (15, 16) address observers' compliance with written instructions for observation at home after emergency department discharge for a head trauma. One study of 90 patients with head trauma from a rural area of North Carolina examined how well a responsible observer followed written instructions for home observation (15). Complete compliance by these observers was reported in 71% of subjects. Compliance was better with patients who had LOC, in younger patients, and if the observer was the patient's mother. Another study addressed effectiveness of home observation and the reliability with which patients' relatives or friends executed a management plan based on written and verbal instructions (16). Outcome assessment was by telephone-administered interview of patients, who were asked if instructions had been carried out properly. These studies report that instructions were frequently not followed, highlighting the problems in any management policy relying on home observation of patients with MTBI.

Studies related to economic costs

We reviewed 16 articles on the economic costs for MTBI and accepted 7 (44%). These include 3 cohort studies (20–22), 2 case series (23, 24), 1 systematic review (25) and 1 economic analysis (26). MTBI-specific data are reported in 5 of these studies (20, 21, 23, 25, 26). Most of these papers presented estimates of direct, healthcare-related costs, and only three provided estimates of both direct and indirect costs (22, 25, 26). In 5 studies, data were collected 15 years or more ago (20, 22–24, 26) and the incidence, severity spectrum, diagnostic work-up, admission policies, compensation and management strategies may have changed since then. Thus, these data are likely outdated and must be interpreted with caution. One study concerns costs in the US Military Medical System (21). Five studies are from the USA, 1 from the UK and 1 from Sweden. As such, these data cannot be directly compared. However, they do indicate that the total cost for MTBI in a modern healthcare system is huge (22, 25, 26). As with other health problems, indirect costs are much higher than direct costs (22, 25, 26). Admission and radiological policies are determining factors for the level of direct costs (23–25).

The task force accepted 1 systematic review, which compares costs between 2 management policies for patients attending hospital with brain concussion (25). Brain concussion was defined as a history of LOC and/or amnesia, and a normal neurological examination, including a Glasgow Coma Scale score of 15 on presentation to hospital. Under 1 policy, patients were observed in hospital and under the other policy, patients received a computerized tomography (CT) scan examination and were discharged to home observation if the CT scan was negative. The reviewed literature included a search of Medline and the Swedish Office of the Health Economic Evaluations Database from 1966 to 2000. The authors identified 4 relevant studies and none of these directly compared the 2 policies. Nevertheless, they were able to use this information to determine that the CT scan policy was less costly. They also performed a decision tree analysis to estimate the direct costs for each of the 2 policies, using probabilities from the literature on CT scan in patients with MTBI and data from Swedish clinical practice. Using these data, they estimated that the costs for the CT scan policy would be about one-third lower than for the observation policy. These findings were robust with regard to variation of costs for hospital stay and CT scan examination, while different costs for emergency department visits and neurosurgery were not considered. However, as pointed out by the authors, conclusive evidence for the assumption of similar clinical outcomes with the 2 management protocols was not available.

Another economic analysis reported estimates of the direct (hospital-stay-related costs for medical goods and services) and indirect costs (economic products, goods, and services not produced because of impairment) for a head injury sample in Olmsted County, Minnesota, USA. The authors also used these estimates to project costs to the entire US population (26). Of the total cost for head injury in the US, which was estimated at approximately $12.5 billion in 1982, the indirect costs accounted for more than 92% of the total.

Another group of authors surveyed the US population on morbidity and economic costs associated with head and spinal cord injury (22). International Classification for Disease (ICD) codes were used to define a cohort of subjects with traumatic brain injury, including 1210 hospital-admitted, head-injured patients. The reported annual incidence rate for all head injuries was 439 per 100,000. The estimated combined, direct and indirect cost for head injury was $2.4 billion for 1974. Costs for MTBI were not separately identified, but because MTBI makes up between 80% and 90% of all hospital admissions, these costs would be considerable.

In another US study, a cohort of 2435 hospital-admitted patients with MTBI from San Diego, California, was examined (20). The annual incidence rate of MTBI was 130.8 per 100,000. The estimated costs for MTBI were $6.2 million for hospital care and $210,000 for paramedic and ambulance costs in 1981.

DISCUSSION

There are few studies providing strong evidence on non-surgical intervention in patients with MTBI. We suspect there are many reasons for this. It may not be surprising that the detection and treatment of life-threatening, intracranial complications has attracted more attention than the prevention and treatment of less well-defined somatic, affective and cognitive complaints. Furthermore, a lack of uniform case definitions, valid diagnostic procedures, and a poor understanding of the natural history and prognostic factors for MTBI complicate the implementation and interpretation of intervention studies. Our review of prognostic studies of MTBI shows that there is an urgent need for well-designed cohort studies to define the prevalence, character and risk factors for persisting symptoms and disability, especially in MTBI adults (2). It seems reasonable that this is the starting point for further research on non-surgical intervention for MTBI, since intervention needs to be directed at those factors that delay recovery. For example, 1 non-randomized study (14) suggests that the treatment of depression in patients with MTBI may improve cognitive function and this should be verified in a proper RCT. Also, without uniform and valid case definitions of MTBI, based on valid diagnostic procedures, it is difficult to compare intervention studies because of the wide spectrum of MTBI severity and symptoms. Our review of diagnostic procedures in MTBI shows that MTBI can include a significant spectrum of severity with regard to intracranial lesions and neurological involvement (1). In summary, the complexity of both the causes and the character of persisting symptoms and disability after MTBI offer significant challenges with regard to study design, outcome assessment, sample size and cost of further research on interventions.

We did not find strong evidence that any non-surgical treatment has a clinically important effect on symptoms or disability after MTBI. A few studies on early intervention provided some evidence that early, limited, educational intervention and activation reduce long-term complaints, and that routine provision of intensive assessment and treatment is not additionally beneficial. The task force recommends that patients with uncomplicated MTBI be provided early, structured, educational information in connection with acute hospital care or within one week after. This should include information about the injury, about common complaints and how to cope with them, reassurance about a good outcome, and information on how to get access to further support when needed. Furthermore, these patients should be encouraged to become active as soon as possible after their injury. Given the health burden of MTBI, there is an urgent need for more intervention studies that address the various individual complaints that some patients have. The evidence does not support routine administration of intensive assessment and intervention to minimize persisting complaints.

We found few studies on the economic costs of MTBI and most of them were performed more than a decade ago, making them outdated. Available data clearly indicate that the total costs for MTBI are high and that the indirect costs (e.g. for sick leave, early retirement and loss of productivity) are the main expense, as they are for other health problems. In addition, acute management policies might have a significant impact on the direct costs.

CONCLUSION

The task force found no high-quality intervention studies on MTBI. Most of the available evidence suffers from methodological problems, including no *a priori* consideration of sample size, losses to follow-up and less than optimal statistical analysis (27). Part of the problem is that the natural history of MTBI is not well defined, and there is an important relationship between poor outcomes and non-brain injury factors, such as psychosocial issues (2). This makes it difficult to know on what to intervene to prevent a poor outcome. The evidence supports a minimal educational strategy that also promotes return to activity as soon as possible. There is no evidence for routine administration of intensive assessment and intervention to minimize persisting complaints in MTBI.

ACKNOWLEDGEMENTS

This work was supported by a grant from Saskatchewan Government Insurance, Canada; the Insurance Corporation of British Columbia, Canada; La Société de l'assurance automobile du Québec, Canada; AFA Insurance, Sweden; Folksam Insurance, Sweden; the Volvo Car Company, Sweden; and Trygg-Hansa, Sweden. Drs Cassidy and Carroll are supported by Health Scholar Awards from the Alberta Heritage Foundation for Medical Research.

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